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INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 05, Issue 03, March 2025, pp : 2177-2180

e-ISSN : 2583-1062
Impact Factor : 7.001

REVIEW PAPER ON NATURE OF HIGH-PERFORMANCE CONCRETE FOR HIGHWAY PAVEMENT

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ABSTRACT

Concrete is an important material in the construction industry. Currently, stone is recognized as one of the best building materials. However, the progress in the stone industry has brought with it many natural problems such as pollution, waste disposal, greenhouse gas (COS) emissions, vegetation and depletion of natural resources. Today, ordinary portland cement (OPC), cementitious materials and other materials are cheap. This improves the properties of the concrete.

However, for every ton of cement produced, approximately one ton of carbon dioxide is produced. Therefore, cement production plays an important role in the production of carbon monoxide, which accounts for about 5% of all CO2 emissions. Developed countries such as the US and the UK are aware of these conditions and are also taxing climate change to reduce their carbon emissions. Therefore, the concept of sustainable development was introduced, which aims to use waste products to improve performance. These waste industries or products play an important role in the sustainable development of the concrete industry, providing the most suitable, economical and practical solutions for waste disposal, thus reducing the harm to the body.

Keywords: High performance computing, Alccofine, effectiveness, compressive strength

1. INTRODUCTION

Demand for High Performance Computing (HPC) is growing, but more demand is in developing countries. The concrete industry in India is growing rapidly due to the demand for construction projects such as high-rise buildings, highways, bridges and structures. Concrete consists of composite materials, fine materials and aggregates, which not only fill the space between them, but also form cement to strengthen the bond between the cement matrix and the aggregate particles. Because the Highway Research Program (SHRP), the American Concrete Institute (ACI), and the Federal Highway Administration (FHWA) provide definitions of HPC, many definitions have been proposed for HPC.

According to the American Concrete Institute, HPC is defined as concrete that meets performance and quality requirements that conventional concrete materials cannot meet. mixing, casting and fixing for individual applications. SHRP defines HPC as concrete that meets certain standards that are said to overcome the limitations of conventional concrete. Design criteria include a maximum water/cement ratio of 0.35.

2. LITERATURE REVIEW

In order to explain the purpose of the research project, a comprehensive literature review of relevant research projects, both experimental and theoretical, was conducted.

Zubair SM(2) examines the use of various fly ash, Alccofine and silica fumes. The fresh and hardened condition of the concrete was examined and strength tests were carried out on the cast at a certain date and the results of the analyzes showed that the compressive strength of the mixture containing Alccofine and fly ash was higher. Due to the small size of the microsilica powder, machinability was reduced, to achieve the same working strength, it is necessary to increase the amount of superplasticizer.

Tsai CT (3) Research on Cement Concrete Pavement Construction Using HPC and High-Performance Steel Fiber Reinforced Concrete (HPSFRC) on Taipei City Bus Lane Investigated the compressive and flexural strength behavior of HPC and HPSFRC at 3, 28 and 56 days of age.

This successful research laid the foundation for the creation of a transportation policy in Taipei City, which proposes to replace the asphalt road system on the bus line near the bus station with a cement concrete road.

P.Muthupriya(4) Effectiveness of concrete behavior investigated by partial replacement of portland cement with metakaolin and fly ash. The authors concluded that the increase in concrete strength was due to the pozzolanic reaction and the addition of metakaolin. Replacement with metakaolin and fly ash results in greater cohesion and less segregation and a denser microstructure of the concrete matrix that improves stability.It can also be seen that the water absorption of the tested samples is lower than that of normal building samples.

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Reddy MVS (5) studied the HPC properties of M80 and M90 grades with and without the use of secondary cementitious materials (SCM). Good plastics should be used to check the work. Higher percentages of superplasticizer are required to improve performance, increase the level of minerals in the mix to achieve the desired mix and strength Percentage of fly ash and metakaolin, HPC grades M80 and M90 have a very low total cost. Compared to conventional concrete, the SCM pozzolanic reaction improves the concrete pore structure and results in lower permeability compared to conventional concrete, again providing greater resistance to chloride ion penetration at high exchange rates.

Patil BB (6) presented a study using metakaolin with some suitable plastics by weight of cement and investigated various properties of M60 grade concrete such as workability, compressive strength and durability.

Using highly reactive metakaolin (HRM) improves performance and strength and increases chemical resistance. When the HRM content increased to 7.5%, the compressive strength increased slightly, but the excess content decreased the w/b ratio, thus retarding the pozzolanic activity, which caused a slight decrease in the compressive strength. The increase in compressive strength is due to the ability of sufficient HRM to react with calcium hydroxide, thereby increasing the hydration of the cement and forming a C-S-H gel.

Patel V and Shah N (7) provided detailed information on the development of high performance concrete in recent years, including the effects of minerals and chemicals used to improve properties.

The paper also lists the product and related terms, including price, life and durability. It was concluded that the strength of concrete work depends on proper concrete mix design, production, casting and processing.

MATERIALS

The materials used for the research work are locally available waste engine oil and two type of soils namely clayey soil and clayey sand. The waste engine oil is collected from a local automobile shop in Kurukshetra. Two soils that is CL type SC type are collected respectively from Samna village near NH-1 in Kurukshetra district.

HIGH PERFORMANCE CONCRETE AND ITS COMPONENTS

As already mentioned in the definition of HPC, it exhibits better properties than normal concrete. According to the Federal Highway Administration (FHWA), HPC is defined as concrete that exhibits improved impermeability, increased durability, and accelerated strength gain over conventional concrete. HPC can be divided into different parts based on strength, which is described in Table below.

Table:1 Classification of HPC on Strength Basis

Compressive Strength (MPa)	High Performance Class
50	I
75	II
100	III
125	IV
150	V

CEMENT

There are generally three types of cement available in the market (33,43,53). JK Lakshmi Grade 43 Ordinary Portland Cement is used in HPC as per IS:8112-1987(41). The physical and chemical properties of cement are shown in Table below.

Table: 2 Physical Properties of OPC43 Grade Cement

S.No.	Properties	Values
1	Sp. Gravity	3.15
2	Consistency	31%
3	Initial setting time	75 min
4	Final setting time	165 min
5	Compressive strength (MPa) at 3 days	26.3
	Compressive strength (MPa) at 7 days	34.9

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Table:3 Chemical Properties of Cement

S.No.	Chemical Properties	Value (%)
1	SiO_2	23
2	Al_2O_3	4.2
3	MgO	0.20
4	Fe_2O_3	1.2
5	CaO	63

FLY ASH

Fly Ash is the industrial by-product produced by electrostatic process from flue gases of power station furnaces fired with coal. According to ASTM C 618-99(41), FA is classified into 2 classes i.e. Class F and Class C. The characteristic of Fly ash showing pozzolanic property similar to cement has motivated the use of Fly Ash as partial replacement of cement in concrete. The specific gravity of locally available flyash used in this study is 2.24.

ALCCOFINE

Alccofine is new generation product with ultrafine size having less calcium silicate content, easily available in India. It has characteristics to improve the performance of concrete in both fresh and hardened phases. Alccofine shows better properties than other admixtures used in India. Alccofine forms C-S-H gel by consuming calcium hydroxide which results in denser structure and gain strength. The specific gravity of Alccofine is 2.86 and is used to increase workability. Various properties of Alccofine is presented in Table below. The Alccofine 1203 is used in the experiment from Ambuja cement outlet as shown in Figure below.

Table:4 Physical and Chemical Properties of Alccofine

Chemical Analysis	Mass%	Physical Analysis	Values
CaO	32-34	Bulk density	600-700kg/m 12000cm²/gm
Al_2O_3	18-20	Surface area	120000cm²/gm
Fe_2O_3	1.8-2	Particle shape	Irregular
SO_3	.3-.7	Particle sized10	<2 μ
MgO	8-10	d50	<5 μ
SiO_2	33-35	d90	<9 μ

Figure.1 Alccofine from Ambuja Cement

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AGGREGATE

Concrete consists of aggregates mixed with cement paste produced from hydration of cement. Some admixtures are used to enhance the concrete properties e.g. workability, to retard setting time, to achieve greater compressive strength, and to resist from unwanted materials. Two types of aggregate used in concrete are coarse aggregate and fine aggregate.

3. CONCLUSIONS

The performance of concrete was a step forward in construction technology. Due to its superior performance, the use of HPC has spread worldwide. Due to its performance in new and cured states, it attracts new technology researchers, application engineers and many industries such as cement and composite materials. Increasing productivity, reducing labor requirements and increasing productivity are also important. Due to the recent needs of the construction industry, the demand for HPC development is fast.

The main objective of each design method is to determine a suitable and economical combination of properties that can be used for the initial testing of concrete, approaching a good balance between low cost and the various needs of concrete. . Spreading the mix evenly creates a mix that only needs to be changed more or less to suit the needs of the function. Experimental studies were conducted to check the preparation and acceptance of the composite design. The mix was made according to ACI's material-based mixing method, mixing HPC grade M60 with a percentage of fly ash and Alccofine. Evaluate the rheological properties of the as-new composite design to determine the suitability of the concrete design.

Compressive strength, splitting tensile strength and flexural strength were calculated with different volumes of fly ash and Alccofine at 28 days.

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